Probing the QCD equation of state with kaon interferometry

Sven Soff, David Hardtke, Steffen Bass, Sergey Panitkin

Correlations of identical particle pairs provide important information on the space-time extension of the particle emitting source as for example in ultra-relativistic heavy ion collisions. In this case, QCD lattice calculations have predicted a transition from quark-gluon matter to hadronic matter at high temperatures. For a first-order phase transition, large hadronization times have been expected due to the associated large latent heat as compared to a purely hadronic scenario. Entropy has to be conserved while the number of degrees of freedom is reduced throughout the phase transition. Thus, one has expected a considerable jump in the magnitude of the interferometry radii and the emission duration once the energy density is large enough to produce quark-gluon matter.

We calculate the kaon interferometry radius parameters for high energy heavy ion collisions, assuming a first order phase transition from a thermalized Quark-Gluon-Plasma (QGP) to a gas of hadrons. At high transverse momenta $K_T \sim 1\,\mathrm{GeV/c}$ direct emission from the phase boundary becomes important, the emission duration signal, i.e., the $R_{\mathrm{out}}/R_{\mathrm{side}}$ ratio, and its sensitivity to T_c (and thus to the latent heat of the phase transition) are enlarged. Moreover, the QGP+hadronic rescattering transport model calculations do not yield unusually large radii. Finite momentum resolution effects reduce the extracted interferometry parameters (R_i and λ) as well as the ratio $R_{\mathrm{out}}/R_{\mathrm{side}}$.

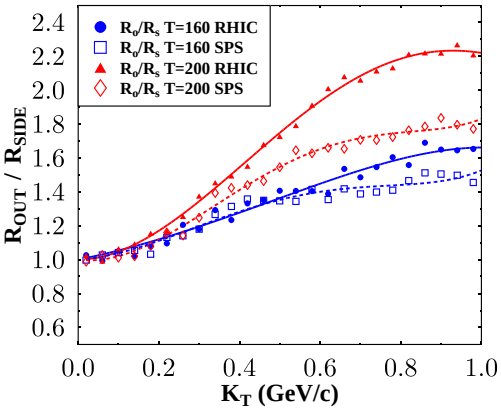

Figure 1: Ratio $R_{\mathrm{out}}/R_{\mathrm{side}}$ for kaons as a function of transverse momentum K_T as calculated with the *QGP+hadronic rescattering model* for SPS and RHIC and critical temperatures $T_c \simeq 160\,\mathrm{MeV}$ and $T_c \simeq 200\,\mathrm{MeV}$.

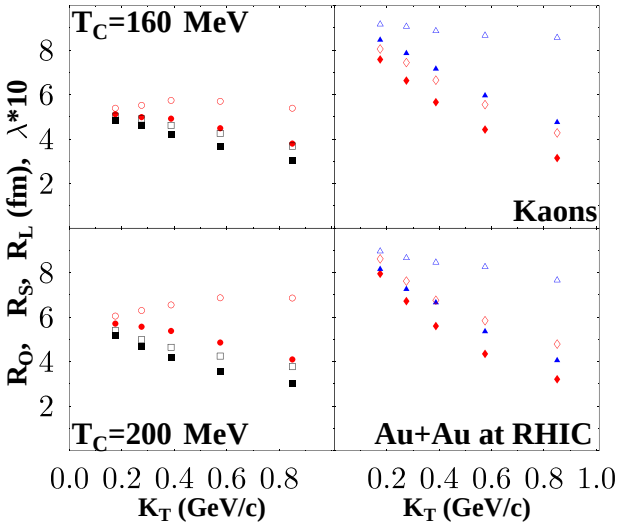

Figure 2: R_{out} (circles), R_{side} (squares), R_{long} (diamonds) and $\lambda \cdot 10$ (triangles) for Au+Au at RHIC and $T_c \simeq 160\,\mathrm{MeV}$ (top) and $T_c \simeq 200\,\mathrm{MeV}$ (bottom). Full and open symbols are results with and without taking momentum resolution effects into account, respectively.

References

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